DOCUMENT RESUME

ED 238 247 FL 014 100

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TITLE Stories: The Function of Structure.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE Aug 83
GRANT BNS-81-09657
NOTE 36p.; Paper presented at the Annual Convention of the American Psychological Association (91st, Anaheim, CA, August 26-30, 1983).
PUB TYPE Speeches/Conference Papers (150) -- Information Analyses (070) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Children; *Discourse Analysis; *Folk Culture; *Recall (Psychology); *Story Reading; *Structural Analysis (Linguistics); Writing (Composition)
IDENTIFIERS *Story Grammar; *Story Structure

ABSTRACT

The differences between story grammar and story schema are outlined and discussed based on research on story understanding by children and adults. The contention of all story grammars is that stories have a relatively invariant structure despite great differences in story content. The importance of structure within folk tales, and the ways in which children incorporate the structure into their knowledge systems, particularly comprehension and memory, are examined. These issues are addressed: finite-state versus context-free grammar, similar considerations of structure in music, ordered consitutents of a story grammar, episodes, research supporting the theory of structural knowledge guiding recall of the story, cross-cultural similarities, the influences of changes in story schema on reading times, and the effects of the structural hierarchy in stories--especially the "levels effect"--in processing. A list of references and illustrative figures are appended. (MSE)

STORIES: THE FUNCTION OF STRUCTURE

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Invited Address to the American Psychological Association,

Anaheim, California, August, 1983

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There is one kind of story that appears in cultures all over the world — the folktale. Sometimes the folktale takes the form of fable or myth, of little moral lessons or stories about how the world began. But regardless of its purpose, for education or entertainment, the genre is recognizable among possible story forms. There are, of course, many kinds of stories. In our modern world, filled with magazines and books, stories take on complex and various structures that are hard to trace to their presumed roots in the folktales of the oral tradition. It is those simpler forms that will be the focus of this talk. These are the stories of our childhood, the ones that our parents read to us, and the ones frequently found in school readers.

When story grammars burst on the psychological scene a decade ago, many people thought that a royal road had been found to uncovering the structure of text — any kind of text. But this was a false hope. Story grammars were invented to describe a particular kind of text. David Rumelhart, one of the pioneers in this effort, described the genre as problem-solving stories (Rumelhart, 1975); Nancy Johnson and I described it as stories from the oral tradition (Johnson & Mandler, 1980). In either case, there are highly specific rules that characterize the structure of such stories. It is in fact because of the existence of such regularities that people are able to form a schema for stories. To form a well organized set of expectations about what one will see or hear typically requires repeated experiences with the event in question. Further, we should not expect to have a schema for text in general. There are too many kinds of texts: novels, history books, journal articles, newspaper articles, recipes, and so forth. Each of these has its own structure and some have more, and more invariant, rules than others. The great advantage of traditional stories for psychological study is, in fact,

their relatively rigid formatting. The same kinds of structures appear over and over again in the folktales of the world. Thus, it was possible to uncover the structure that they do have, and to investigate how people incorporate that structure into their knowledge systems. Because of the relative lack of variation in the formats of stories from the oral tradition, they have provided us with an easy avenue for the exploration of schema formation and use.

Before proceeding further, it is important to distinguish between a story grammar and a story schema. A story grammar is a rule system devised for the purpose of describing the regularities found in one kind of text. The rules describe the units of which stories are composed, that is, their constituent structure, and the ordering of the units, that is, the sequences in which the constituents appear. The story grammar describes the structure out there in the world, if you will, even though the stories themselves are the product of the human mind. A story schema, on the other hand, is a mental structure consisting of general knowledge about the way in which stories proceed. The close connection between a story grammar and a story schema arises from the fact that the story schema is a mental reflection of the regularities that the processor has discovered (or constructed) through interacting with stories.

The distinction between a story grammar and a story schema has not always been clearly made, but that in itself does not explain why the very notion of a story grammar (or a story schema based on it) has distressed some psychologists so much. Along with great interest and burgeoning research programs based on these ideas came a rush of criticism. The criticisms seem to have been based on several misconceptions. One such misconception is that a grammar is a purely linguistic notion. However, a grammar need not carry any overtones of a built-in or native set of linguistic categories, nor does

it commit one to any particular type of linguistic processing. After all, a grammar is merely a rule system, describing materials in terms of a set of units and the ways in which the units are sequenced. Serial patterns of all sorts can, and have been, described by grammars (see Jones, 1974). A grammar is a convenient notational system, ideally suited for describing fairly simple structures of the type involved in stories.

Why then, such concern over whether a story grammar is a finite-state or a context-free grammar (see Black & Wilensky, 1979; Johnson-Laird, in press)? I believe that the controversy, at this point in our research on stories and story understanding, is a trivial one. As Rumelhart (1980) noted, he used a context-free grammar to characterize story structure because it was such a good notational system to capture the recursion so often found in stories. And as I have stated elsewhere (Mandler, & Goodman 1982), an augmented transition network (ATN) might be equally useful for purposes of describing story structure. It would be fairly easy to recast the Mandler and Johnson (1977) story grammar into an ATN device. Yet I suspect that would not satisfy story grammar critics, because I think at heart there is a more fundamental objection, although not one that has been made explicit. Part of the objection to characterizing story structure by any rule system is that it implies that people have highly abstract knowledge about stories. Most of the opponents of the very concept of story structure are those who demand specific content to all psychological knowledge. These psychologists insist that stories consist of plot units such as requests that are honored, denied or bungled, or fleeting success, and so forth (Lehnert, 1982); or that story understanding is guided solely by content-specific heuristics, such as our knowledge of what various types of villains are apt to do (Weaver & Dickinson, 1982). Others deny that stories have any kind of underlying structure (e.g.,

Black & Wilensky, 1979). Johnson-Laird (in press) suggests that any text can be understood simply through the joint operations of referential cohesion and plausibility, with the implication that no purpose can be served by knowledge of an underlying structure.

I find such claims puzzling. It has been shown over and over again that people either discover structure inherent in the world or impose structure upon it. The work of Restle (1970) and Klahr, Chase, and Lovelace (1983), among others, shows that people either find or impose structure on nonmeaningful sequences of digits or letters. Consider the alphabet; people segment this long arbitrary sequence into chunks. The chunks form a hierarchical structure which has noticeable effects on processing; for example, entry to the sequence for purposes of reproducing it tends to be restricted to chunk boundaries (Klahr et al., 1983). Since the alphabet is an arbitrary set this is a case in which the structure had to be invented. Klahr et al. propose that the boundaries of the chunks derive from the "Alphabet Song". The song in turn presumably has the structure it does because of the tendency of the mind to construct chunks of limited size and because of the mnemonic value of the rhymes that appear at various points in the sequence. If people impose structure on truly arbitrary material, how much less surprising that they discover the structure that actually exists in many parts of the environment.

Meaning does not exist until some structure, or organization, is achieved, and the case can be made that the deeper the understanding of a domain the more abstract the structure that has been uncovered or imposed. Discovering sonata form in music is one such example; the structure of theory, such as the group structure underlying Piaget's theory of the mind, is still another. Why do we impose such concreteness on our subjects' thought when we, as psychologists, so delight in abstract structural enterprises?

To illustrate the abstract nature of many cognitive structures, consider the musical schemas common in our culture. Schematic representations of typical musical sequences are gradually learned during childhood. In the adult, these schemas include information about the intervals of the diatonic scale, chordal structures, keys, and the distances between musical keys. As Krumhansl and Keil (1983) have noted, empirical support for the representation of these properties can be found in judgments of tones and of chords and also from memory performance. They state that "through experience with well-structured musical sequences, listeners have apparently identified certain underlying regularities that by their nature must be encoded in a form more abstract than the pitch frequencies of the musical stimulus". Krumhansl and Kessler (in press) describe this kind of representation as a hierarchy of stabilities within the set of musical tones, from which the structure of chords and musical keys is derived. This hierarchy indicates certain tones as structurally central to the tonal system and forms the basis of musical organization (particularly the tonic, and to a lesser extent, the third and fifth steps on the diatonic scale). The hierarchy influences perceptual judgments; for example, given an incomplete series of notes from the major scale, musically trained listeners prefer completions from scale tones, as opposed to nondiatonic tones, with special preference for the tonic. Nondiatonic tones are also more difficult to remember than diatonic tones, when presented in a tonal context.

Thus, at a highly abstract level we have acquired sets of expectations about musical structure, which govern the way that we encode and remember music. Further, children acquire the basics of this structure at a relatively young age. It is especially noteworthy that children's judgments of which tones serve best to finish an uncompleted melody indicate that the diatonic-

nondiatonic distinction is not only acquired early but is more important to the judgments than concrete physical properties of the melodies being heard, such as pitch height. It seems that children have learned which pitches belong to particular tonal contexts, even when they have not heard the particular melody before.

I submit that the same phenomenon takes place with stories. From an early age we hear a particular class of stories with highly similar structure and we gradually form an abstract representation of that structure. The emphasis I am placing on structure here, however, should not be taken to deny the importance of specific world knowledge in understanding stories. The misunderstanding of the positive value of structure has led some psychologists to complain that story grammar theory is all syntax and no semantics; after all, they say, stories are about specific people involved in specific situations and we must understand concretely what they are doing and why. To be sure, but what is at issue is not that content-knowledge is important, since no one would deny it, but whether or not there is an organization to a story schema irrespective of the particular content involved.

Before turning to the details of story structure, I will mention one more example of the uses of abstract structural knowledge. Gick and Holyoak (1983) have provided an interesting discussion of the importance of highly general or abstract schemas in problem solving. They asked how knowledge needs to be represented to use a successfully solved problem in one domain (for example, a military problem) as an analogy to solve a new problem in a different domain (for example, a medical problem). The content of the solved problem in the military domain cannot usually be used as an aid to solving the new problem because the content itself arouses the wrong associations. Gick and Holyoak argue that one needs an abstract schema that maps onto both domains equally

well, a schema that will provide a set of retrieval cues that the content alone cannot.

You may remember Duncker's (1945) old radiation problem in which the goal was to destroy a tumor. The resources were powerful X-rays, but with the constraint that one couldn't administer them from a single direction without killing the patient. The solution was to apply lower intensity rays along multiple paths. This is the medical problem. Now consider a military problem in which the goal is to capture a fortress. You have the resource of a sufficiently large army, with the constraint that the army can't reach the fortress by a single road. The solution is to send small groups of men along several roads converging on the fortress.

These two problems obviously have very different content, and Gick and Holyoak found (as have other researchers on similar tasks) that reading the solution to the army problem was typically of little use to subjects trying to solve the tumor problem. Gick and Holyoak suggest that what was needed was two successfully solved analog problems that could be used to form a more abstract convergence schema. Such a schema might be of the form: the goal is to use force to overcome a central target, with resources of sufficiently great force, and the constraint of not being able to apply the full force along a single path; the solution is to apply weaker forces along several paths that converge on the target. When Gick and Holyoak gave subjects two analog problems, from the same or from dissimilar domains, and had them write down how the two training problems were similar to each other, solution of a new problem was much more frequent. Furthermore, analysis of the written reports indicated that when a good abstract schema of the type just described was produced, the correct solution to the new problem was almost always found.

Although these experiments and the issues involved in analogical problem solving are more complex than this brief summary indicates, I hope that it conveys the potential value of an abstract schema, couched in terms of goals, resources, constraints, solution plans, and outcomes. This level of abstraction is very similar to the level at which we have described the structure of simple stories.

The contention of all story grammars is that stories have an underlying structure that remains relatively invariant in spite of gross differences in content from story to story. This structure consists of a number of ordered constituents. Traditional stories begin with a setting, which introduces a protagonist and other characters, and often includes statements about the time and locale of the story. The setting is followed by one or more episodes that form the overall plot structure of the story. No matter how many episodes, however, each one has the same underlying structure. A simplified version of the structure of a simple two-episode story is shown in Figure 1. Following the setting the first episode occurs. The episode starts with a beginning constituent--some event happens which gets the episode going. The beginning is followed by a development, which has several parts. First the protagonist reacts in some way to the events of the beginning. Typically, this consists of a complex reaction, that is, a simple (emotional or cognitive) reaction followed by the formulation of a goal. There follows a goal path, which consists of an attempt to reach the goal, and a statement of the outcome of that attempt (either success or failure). The episode comes to a close with an ending constituent, which provides some kind of commentary on the preceding events. Sometimes an ending consists of a statement about the long-range consequences of the episode; sometimes the protagonist or other character reacts to the events that have taken place.

Each of these constituents has a specific type of connection to the one that follows. The setting provides atemporal background information and is connected to the first episode by an "and" connection. Within an episode, however, the connections between constituents are all causal ones. Each constituent is the cause of the next. Episodes, on the other hand, can be connected either causally or merely temporally. In Figure 1 a temporal connection is illustrated. Causal conections between episodes occur through the embedding property of the outcome or ending of an episode; that is, these units may be rewritten, or expanded, into entire new episodes. Thus, episodes can be strung together in a number of ways, and quite complex structures can result. See Figure 2 for a representative example. Nevertheless, the structure of each episode is similar and fairly simple in nature, making it relatively easy for the listener to compartmentalize the story as it unfolds.

I'm not going into more detail about episodic structure because I want to concentrate on the simple constituents shown in Figure 1. However, I do want to make a comment about the hierarchical nature of the structure represented. There are various kinds of hierarchies. The most familiar one is a taxonomy or class inclusion structure in which each unit is an example of, or a member of, the next higher unit. But the kind of hierarchy describing story structure is tha of a collection (see Markman & Seibert, 1976), not a class inclusion system. Each unit is a part of the next higher unit. For example, an attempt is not an example of, or a member of, a goal path; it is part of a goal path. Related to this part-whole nature of the hierarchy are the connections, or relations, between units. As just mentioned, most of the relations are causal ones, but some are temporal and some even atemporal. But the units are related directly to each other and not merely associated by virtue of their membership in a superordinate class. A

dog and a lion are related by both being members of the class of mammals; but an attempt is related to an outcome by a causal connection. I will return to this issue later when discussing the so-called "levels effect" in recall of stories.

My current aim, however, is to show how knowledge of the structure of stories is used during comprehension and memory. Most of the early studies of story processing used recall as the principle measure. The work was guided by fairly general predictions derived from the initial work on story grammars and from intuitions about those aspects of story structure that people might be expected to have acquired from their experience with stories (see Mandler & Johnson, 1977). For example, it was predicted that stories having canonical form (that is, having all the prescribed constituents in their correct sequence) would be better recalled than stories missing some constituents or presented in a mixed-up order. This result has been found in many studies, including some that have used children as young as three years of age (e.g., Johnson & Gandel, 1982; Glenn, 1978; Thorndyke, 1977). So far so good. But this kind of result does not tell us about the structure of a story schema per se. The finding is comparable to studies comparing recall of categorized and uncategorized lists. A list with categorical structure, or any kind of structure for that matter, is better recalled than one with no structure at all. Similarly, better recall of a story told in its proper sequence might be considered akin to better recall of a categorized list when the categories are presented in blocked fashion instead of being randomly intermixed.

Another finding often demonstrated is that subjects are more likely to recall the central material from story constituents than elaborations on these units (Mandler & Johnson, 1977; Omanson, 1982; Stein & Glenn, 1979). This is a more informative finding. It indicates that the units described by the

story grammar do constitute the gist of a story, and in that sense provide a reasonable picture of the story's structure. Gist recall, of course, is the norm for the recall of any lengthy text. The crucial point is that the particulars of the gist (that is, its defining characteristics) were specified by the theory.

Two other sets of results move us still closer to our goal of validating the presence of structural knowledge guiding recall. One of these is that additions of new material in recall (other than elaborations) supply constituents deleted from the story as told, and confabulations tend to preserve the form of a constituent that is being incorrectly recalled (Glenn, 1978; Mandler, 1978; Stein & Glenn, 1979; Whaley, 1981). These kinds of findings are impressive because people must be using pre-established structural knowledge of the constituent structure of stories to fill in gaps in their memory.

Even more dramatic results are found concerning the ordering rules for story constituents. In several studies in my laboratory we have presented stories consisting of two temporally connected episodes, that is, stories with the structure illustrated in Figure 1. The episodes were either shown in their canonical form (that is, presented sequentially as illustrated) or were "interleaved" that is, the beginning of the first episode was followed by the beginning of the second episode, then back to the first episode, and so on. The stories were understandable in either version, but both children and adults tended to separate the two interleaved episodes in their recall, thus following canonical story structure rather than the story as told (Mandler, 1978). Even when told to retell the stories exactly as they heard them, that is, to maintain the interleaved form, they had great difficulty in doing so (Mandler & DeForest, 1979). And when delayed recall was used, the tendency to produce the ideal form became even stronger.

Still another recall finding is that the same pattern of recall, in terms of which constituents are recalled the best, has been found for stories of widely varying content and for many different populations. To cite just some examples of the populations that have been studied, dyslexic and backward readers (Gold, 1983; Weaver & Dickinson, 1982) language-impaired children (Graybeal, 1981. learning disabled adults (Worden, Malmgren, & Gabourie, 1982), and deaf children (Gaines, Mandler, & Bryant, 1981) all show the workings of the same story schema in their recall, since all show highly similar patterns of results.

The same patterns are found cross-culturally as well (Mandler, Scribner, Cole, & DeForest, 1980). We presented stories that had previously been used in a study of American children and college students (Mandler & Johnson, 1977) to a wide sample of a Vai-speaking population in Liberia. The subjects ranged in age from six to fifty and varied in degree of literacy. Some had never been to school and were not literate, others had not been to school but had learned to read, still others had been schooled and were literate. The patterns of recall from these various groups and from the American groups are shown in Figure 3. Adults from both cultures are shown on the left, and children of both cultures on the right. It can be seen how alike the patterns are. The only clearly significant difference was in amount recalled by children of either culture in comparison with adults of either culture. And even though children recall less than do adults, they tend to recall the same sorts of things. As for adults, literacy or schooling — even university training — does not influence the pattern or amount recalled.

These data stand in dramatic contrast to many other cross-cultural data, in which the absence of schooling has a detrimental effect on performance (see Cole & Scribner, 1977). The findings suggest that at least one kind of story

schema is a cultural universal, an hypothesis supported by finding stories with similar structure from all parts of the globe. It is encouraging to find the possibility of structural invariants that cut across the sea of differences among populations that so often appear in the psychological literature.

The studies just described all investigated recall. But does a story schema influence the way in which we understand stories as well as the way in which we remember them? It might be possible to comprehend a story in a largely data-driven fashion, using existing knowledge only to guide local connections among sentences. On this view, which has occasionally been propounded (see Alba and Hasher, 1983), a story schema would only influence retrieval processes, not encoding processes. Although such a point of view seems unlikely, implying as it does that we do not make use of our cognitive structures to guide our intake of information from the world, nevertheless it seems important to demonstrate that a story schema influences the encoding process itself.

I will summarize briefly some recent data on the way in which a story schema influences reading times (Mandler & Goodman, 1982). One of the effects one would hope to see would be an influence of the boundaries of units on processing. Each of the constituents of an episode can be considered as a local topic unit in the larger macrostructure (the overall structure) of a story. When a unit finishes, it tells the reader that the story line is moving ahead and that next topic has begun. Thus, the reader can use knowledge of story structure to recognize and categorize incoming sentences into their relevant topics. This knowledge is not purely schema-driven; as in all processing it must interact with the particulars of the incoming information. Since stories vary widely in how elaborately each unit is told,

the reader does not necessarily know that a given unit has finished until the next has begun. When the topic shifts, however, the reader can discern that the former unit is finished. We hypothesized that reading time would slow down at this point, as the reader formulates a macroproposition corresponding to the previous unit (see Kintsch and van Dijk, 1978) and begins to formulate the content of the next. The story schema would thus enable the reader to form a coherent representation of the story as a whole. The bridging information that connects the units is supplied by the schema, and does not have to be built up afresh, as presumably must be done when reading unfamiliar types of prose.

We predicted, therefore, that we would find slower reading times at the beginning of each of the units of an episode. We wrote a number of stories, in which each unit consisted of two sentences. We controlled potentially confounding factors such as length of sentence, word frequency, frequency of pronominal reference, and importance of sentences to the story. We also insured that first sentences of units did not introduce more new nouns or repeat old nouns less frequently than in other sentences. Armed with these controls we could obtain reading times that were sensitive to the one factor we wanted to examine: structure. And we were rewarded, finding a zig-zag pattern of reading times across story units, with the first sentence of a unit being slower to read than the second sentence. As a final check on extra-structural factors that might have produced this pattern of reading times, we ran a control experiment in which the same sentences were presented, in pairs, but each pair came from a different story, so that story structure was removed. Under these circumstances the systematic differences in reading times among the sentences disappeared.

We found the same differences in speed of cued recall. Subjects were asked to recall the immediately following sentence upon being presented with one of the sentences in the story. Half of the cues were the first sentences of a unit, half the second. We assumed that when both cue and target were within a unit, it would be faster to locate the target than when the cue was in one unit and the target in another. Again, the results confirmed this prediction. Subjects were much faster to recall a target when its cue was in the same unit. In the control experiment, in which story structure was removed, this difference disappeared.

These results provide clear evidence for the psychological validity of the constituents posited by the story grammar, in the sense that they have been shown to affect the rate at which stories are understood and recalled. These effects are structural ones; story constituents have boundaries at which processing is different than in the interior of these units.

Now that we have shown the validity of the units, we can ask about the ordering rules. Is it true that there is a best sequence for telling stories and that it is not good to delete units? Black and Wilensky (1979) have claimed that there are no such rules for stories, that any unit can be moved or deleted as long as the reader can infer the missing component or the real-time sequence. They did not provide any data to support this notion, however. They merely cited a few story fragments such as "John needed a book from the library and it was soon in his possession", claiming that since such fragments, consisting of a goal and an outcome, are comprehensible, therefore attempts can be deleted from stories.

The issue is not whether people <u>can</u> understand stories with deleted components; if not too many components are missing they obviously can, given enough time and effort. We can also understand slightly scrambled sentences

or sentences missing determiners; yet such sentences violate the canonical form of English. Since people can understand all sorts of odd things in one way or another, a more reasonable test of the ordering rules than comprehensibility per se, would be to move constituents around in stories and measure comprehension time. If the ordering rules are valid, then violations of them should slow down comprehension. This is exactly what we found (Mandler & Goodman, 1982). We wrote stories in normal form and then systematically moved a single sentence one sentence away from its expected position; that is, we inverted the ordering of two story units. Further, we gave the moved unit a temporal marker, such as "since" or "because" so that the real-time sequence of events would be unambiguous, as well as the causal relations that were being portrayed. Thus, any disruption of comprehension would not be due to ambiguity or bizarreness, but could be ascribed to a violation of expected ordering and the necessity of inferring the missing material. We tested each of the units of episodes in this fashion and found that in all cases reading times were slowed down by this sort of deletion and movement. It appears that there is indeed a best way to tell a story.

By now we have learned a good deal about a story schema. It reflects many of the regularities found in story structure. First, its organization is hierarchical. It contains the concept of an episode and a number of constituents nested under episodes. Thus, a series of units with definite boundaries have been established as part of the schema. Second, we have found that a story schema is ordered; at present there appears to be a single ordering rule, although the data base is still too small to rule out some optional ordering rules that have been suggested (Johnson & Mandler, 1980). Third, the schema is abstract, in the sense that it does not require any particular content. Although the domain is limited and the definitions of the

units restrict the types of content that may occur, within those restrictions the content can and does vary widely. Fourth, we have determined some of the ways that these elements of the structure of a story schema influence processing, both at the time of encoding and at retrieval.

I now want to return to the issue raised earlier of the type of hierarchical structure being described here. There are other ways of describing the hierarchical structure of stories than a story grammar, and other claims that have been made about the uses of story structure in processing. In particular I want to consider briefly what is known as the "levels effect" in the processing of narrative texts. This effect refers to the fact that people are more likely to remember high-level propositions than low-level ones. The meaning of this claim, however, is crucially dependent on how one uses the term "proposition" and on what it is that confers "high-level" status on a proposition.

It is usually assumed that high-level means high in a hierarchy. The evidence most often cited to support the levels effect is work by Kintsch and his colleagues and by Meyer (1975). It is important to be clear about the range over which all such propositional analyses work. For example, Kintsch, Kozminsky, Streby, McKoon, and Keenan (1975) studied the hierarchical relationships among small propositions in two or three related sentences forming a short paragraph. An example of this kind of analysis for one of their paragraphs is shown in Figure 4.

This analysis produces a connected graph, which has a type of hierarchical character. But the hierarchy is neither a class-inclusion nor a collection hierarchy. Instead it consists of the first main verb-based phrase, with adjectives and prepositional elaborations nested under it, and later new phrases that refer to any of the previous arguments nested under it

as well. The analysis provides the microstructure of the text. That is, it expresses each idea into a proposition, consisting of a relational term and a relatively small number of arguments. It keeps track of argument repetition, which provides some of the coherence of text, and informally captures the gist of individual sentences by placing their skeletal verb-based phrases higher in the hierarchy than their elaborations.

What Kintsch and his colleagues found (as did Gomulicki, 1956, before them) was that high-level propositions (such as that the Babylonians built a garden) are recalled much better than the lower-level propositions (such as that the garden was beautiful). They also found tha the number of arguments and the number of repeated arguments in these passages affecting reading time. These data are important, but it is equally important not to confuse the hierarchical implications of this kind of microstructure, which describes the semantic content and connectivity of sentences, with the overall hierarchical structure (or macrostructure), which provides the gist of the text as a whole. Kintsch (1977) is quite clear about this. The macrostructure, according to him, is derived from the microstructure by an interactive process that includes knowledge of narrative structure (that is, various story constituents grouped into a story schema). To my knowledge no one has attempted to study the relative importance of the hierarchical levels of Kintsch's macro-structures (that is, whether some constituents are "higher" than others) — yet it is those structures which correspond to a story grammar, not the microstructural analysis such as shown in Figure 4. The two sentences in Figure 4 could serve as the setting of a story; thus, the levels represented there would be <u>within</u> a single constituent, not between the various story constituents.

Thorndyke (1977) extended the notion of levels of importance to apply to the structure of stories as a whole, but his levels are different from those of Kintsch. One reason that both kinds of work have been lumped together is the use of the term "proposition" to refer both to the microanalysis of sentences and to sentences as a whole. (I confess to have been guilty of this sin as well). When Thorndyke talks about the hierarchical levels of propositions in stories he is referring to the importance of clauses or simple sentences, not to relational terms and their arguments. I will refer to such clauses and sentences as story statements, to contrast them with propositions. Thorndyke describes the structure of stories as consisting of a Setting, Theme, Plot and a Resolution. These categories are couched in the form of a hierarchical tree structure, which is related to but not the same as Kintsch's macrostructure or our story grammar. In particular, he makes claims for this structure that we do not. He states that the number of nodes separating a terminal constituent from the top of the tree indicates "the scope, generality, and hence importance of the proposition" (Yekovitch & Thorndyke, 1981). Proposition here, of course, should be taken to mean a story statement.

Scope, generality, and importance, however, are not all the same thing, nor are they necessarily associated with the top levels of all tree structures. Consider a class inclusion hierarchy used to express a taxonomic structure. In such a hierarchy the higher the level, clearly the broader the scope (e.g., animal vs. mammal). However, importance cannot be equated with scope, but must be related to what the hierarchy is used for. If one wishes to contrast a lion and a snake, for example, the intermediate level of the tree having to do with a mammal-nonmammal distinction is more important than the higher level of a vertebrate-invertebrate distinction.

Next consider a story schema or macrostructure. This kind of hierarchy is a collection, in the sense that higher-level constituents consist of separate subparts, each of which must be present for the higher-level component to exist. The higher-level constituents do have a larger scope, but it is not obvious that they are more general. An example from sentence structure may clarify this point. A noun phrase, consisting of a determiner, adjectives, and a noun, has a larger scope than any of its individual parts, but in at least some sense it is not more general, but less so; "a large green book" is less general than "book". It is also obvious that importance is orthogonal to this classification; "a" and "book" both appear at the same level in the hierarchy, but one of these parts is more important than the other.

A story grammar is much like a parsing tree for sentences, yet no one would assume that as one moves down levels of a sentence's phrase structure that one moves to less important aspects of the sentence. Relative clauses, for example, are nested under higher levels of the tree, yet may be the most important aspects of a sentence. In a similar fashion, in a multi-episode story with outcome-embedded or ending-embedded episodes, successive episodes also move lower down the tree structure, yet do not become less important thereby.

Nevertheless, several theorists have claimed that their models of story structure represent both constituent structure and importance at the same time; as one moves down the tree the importance of constituents is said to decrease (e.g., Thorndyke, 1977; Rumelhart, 1977). In some reports as many as 16 levels have appeared, yet it is often not clear exactly what the levels consist of. Some of them appear to be constituents as defined here; others appear to be within-constituent elaborations, yet the implication is that

anything on the same level is equally important, and that each level is measurably different from neighboring levels. I worry that this approach conflates two different kinds of hierarchical structures, making the notion of a level's effect difficult to interpret.

A level's effect in processing could be due to the micropropositional structure, or to the macrostructure, or to a mix of the two. To give a single example, Cirilo and Foss (1980) used Thorndyke's grammar to place single sentences either at a "high" level or at a "low" level in two stories. They found that a sentence placed at a high level was slower to read and better recalled than when it occurred at a low level. However, in the example story they used in their article, the sentence occurring at a high level was the statement of an outcome of an episode, whereas the same statement at a low level formed part of a simple reaction (and was not well formed, either, since it did not relate to the following goal). Simple reactions are typically faster to read and more poorly recalled than other statements in stories. So at this point we do not know if this particular level's effect was due to height in a tree structure, or to the particular categories that were used in the two cases, or to the relation of the individual sentences to their respective categories.

What is needed to resolve the issue of a level's effect in story processing is to combine the various analyses that have been mentioned here. Kintsch's propositional analysis provides some predictability in terms of argument overlap and other aspects of the connectivity of statements at a micro-level of analysis. An analysis of the causal and other relations of individual sentences to the constituent of which they form a part would provide a different source of predictability at an intermediate level of analysis. A story constituent analysis provides still another source of

information, at the macrostructural level. If these three types of analysis could be amalgamated into a single comprehensive system, it should provide a theory of great predictive power.

In the meantime we must not confuse levels of importance with a story schema. Importance arises from a number of factors, only one of which is the overall structure of a story. Other factors include emphasis or repetition on the part of the author or storyteller, and as discussed earlier, the main ideas in a sentence regardless of their relation to the story plot. A hierarchy of importance levels that mixes these components together is not an enduring cognitive structure in the way that a story schema is. Indeed, in the absence of such a guiding schema, as in more loosely structured texts, people are more apt to be influenced by emphasis, repetition, and sentence structure than they are by the overall structure of the material. Any text can be dissected into micropropositions and its statements laid out into a hierarchy of importance, but unless it conforms to a familiar structure, it is the more local factors affecting importance, such as repetition and emphasis, that determine what is picked up on a single exposure.

This brings me to my final point. It is sometimes said that current cognitive psychology is functional in spirit because of its emphasis in processing. That may be, but those who work on schema theory have shown a strong interest in describing mental structures. Some aspects of those structures are undoubtedly due to the organizing propensities of the mind, but many others are due to the structure of information in the environment. One of the most prominent clashes in psychology today is between those of the cognitive and the Gibsonian persuasions. Yet it seems to me that their battles are often misguided, with too much emphasis on the virtues of data-driven processing under the control of a structured environment versus

conceptually-driven processing under the control of a structured mind. As in most other quarrels in life, there is truth on both sides of the argument and neither argument is correct in itself. There are indeed many kinds of structure in the environment, but except at fairly simple perceptual levels, they must be learned through experience. When any of them are learned, they become mental structures which guide the course of future information extraction. The knowledge that is so gained does not consist of lists of unrelated facts, nor of a heap of haphazard associations. As Piaget so often emphasized, the mind has a tendency to organize itself. The study of schemas is one part of the search for what that organization looks like. One of the best ways of arriving at that organization is to examine the regularities in the world upon which the organization is based. I hope I have convinced you that we have come fairly far in this search in so far as traditional stories are concerned. A small domain, perhaps, but an interesting one because of the abstractness of the organization that people form and use.

Footnote

Preparation of this talk was supported in part by NSF Research Grant BNS 81-09657. Requests for reprints should be sent to Jean M. Mandler, Department of Psychology C-009, University of California, San Diego, La Jolla, CA 92093.

References

Black, J. B. & Wilensky, R. An evaluation of story grammars. Cognitive Science, 1979, 3, 213-230.

Cirilo, R. K. & Foss, D. J. Text structure and reading time for sentences. Journal of Verbal Learning and Verbal Behavior, 1980, 19, 96-109.

Cole, M. & Scribner, S. Cross-cultural studies of memory and cognition. In R. V. Kail & J. W. Hagen (Eds.), Perspectives on the development of memory and cognition. Hillsdale, NJ: Erlbaum, 1977.

Gaines, R., Mandler, J. M., & Bryant, P. Immediate and delayed story recall by hearing and deaf children. Journal of Speech and Hearing Research, 1981, 24, 463-469.

Gick, M. L., & Holyoak, K. J. Schema induction and analogical transfer. Cognitive Psychology, 1983, 15, 1-38.

Glenn, C. G. The role of episodic structure and of story length in children's recall of simple stories. Journal of Verbal Learning and Verbal Behavior, 1978, 17, 229-247.

Gold, R. Recall of story schema categories by reading disabled adults: Effect of mode of presentation. Perceptual and Motor Skills, 1983, 56, 387-396.

Gomulicki, B. R. Recall as an abstractive process. Acta Psychologica, 1956, 12, 77-94.

Graybeal, C. M. Memory for stories in language-impaired children. Applied Psycholinguistics, 1981 2, 269-283.

Johnson, N. S., & Gandel, R. G. Effects of story organization on preschool children's recall. Article in preparation, 1982.

Johnson, N. S. & Mandler, J. M. A tale of two structures: Underlying and surface forms in stories. Poetics, 1980, 9, 51-86.

Johnson-Laird, P. N. Mental models. Hillsdale,NJ: Erlbaum, in press.

Jones, M. R. Cognitive representations of serial patterns. In B. H. Kantowitz (Ed.), Human information processing: Tutorials in performance and cognition. Hillsdale, NJ: Erlbaum, 1974.

Kintsch, W. Memory and cognition. New York: Wiley, 1977. (b)

Kintsch, W., Kozminsky, E., Streby, W. J., McKoon, G., & Keenan, J. M. Comprehension and recall of text as a function of content variables. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 196-214.

Kintsch, W. & van Dijk, T. A. Toward a model of text comprehension and production. Psychological Review, 1978, 85, 363-394.

Klahr, D., Chase, W. G., & Lovelace, E. A. Structure and process in alphabetic retrieval. Journal of Experimental Psychology: Learning, Memory, and Cognition, 1983, 9, 462-477.

Krumhansl, C. L., & Keil, F. C. Acquisition of the hierarchy of tonal functions in music. Memory & Cognition, 1983, in press.

Krumhansl, C. L., & Kessler, E. J. Tracing the dynamic changes in perceived tonal organization in a spatial representation of musical keys. Psychological Review, in press.

Lehnert, W. G. Plot units: A narrative summarization strategy. In W. G. Lehnert & M. R. Ringle (Eds.), Strategies for natural language processing. Hillsdale, NJ: Erlbaum, 1982.

Mandler, J. M. A code in the node: The use of a story schema in retrieval. Discourse Processes, 1978, 1, 14-35.

Mandler, J. M. & DeForest, M. Is there more than one way to recall a story? Child Development, 1979, 50, 886-889.

Mandler, J. M. & Goodman, M. S. On the psychological validity of story structure. Journal of Verbal Learning and Verbal Behavior, 1982, 21, 507-523.

Mandler, J. M. & Johnson, N. S. Remembrance of things parsed: Story structure and recall. Cognitive Psychology, 1977, 9, 111-151.

Mandler, J. M., Scribner, S., Cole, M., & DeForest, M. Cross-cultural invariance in story recall. Child Development, 1980, 51, 19-26.

Markman, E. M., & Seibert, J. Classes and collections: Internal organization and resulting holistic properties. Cognitive Psychology, 1976, 8, 578-595.

Meyer, B. J. F. The organization of prose and its effects on memory. Amsterdam: North Holland, 1975.

Omanson, R. C. An analysis of narratives: Identifying central, supportive, and distracting content. Discourse Processes, 1982, 5, 195-224.

Restle, F. Theory of serial pattern learning: Structural trees. Psychological Review, 1970, 77, 481-495.

Rumelhart, D. E. Notes on a schema for stories. In D. G. Bobrow & A. Collins (Eds.), Representation and understanding: Studies in cognitive science. New York: Academic Press, 1975.

Rumelhart, D. E. Understanding and summarizing brief stories. In D. LaBerge & S. J. Samuels (Eds.), Basic processes in reading: Perception and comprehension. Hillsdale, NJ: Erlbaum, 1977.

Rumelhart, D. E. A reply to Black and Wilensky. Cogntive Science, 1980, 4, 313-316. (a)

Stein, N. L., & Glenn, C. G. An analysis of story comprehension in elementary school children. In R. O. Freedle (Ed.), New directions in discourse processing (Vol. 2). Norwood, NJ: Ablex, 1979.

Thorndyke, P. W. Cognitive structures in comprehension and memory of narrative discourse. Cognitive Psychology, 1977, 9, 77-110.

Weaver, P. A. & Dickinson, D. K. Scratching below the surface structure: Exploring the usefulness of story grammars. Discourse Processes, 1982, 5, 225-243.

Whaley, J. F. Readers' expectations for story structures. Reading Research Quarterly, 1981, 17, 90-114.

Worden, P. E., Malmgren, I., & Gabourie, P. Memory for stories in learning disabled adults. Journal of Learning Disabilities, 1982, 15, 145-152.

Yekovich, F. R., & Thorndyke, P. W. An evaluation of alternative functional models of narrative schemata. Journal of Verbal Learning and Verbal Behavior, 1981, 20, 454-469.

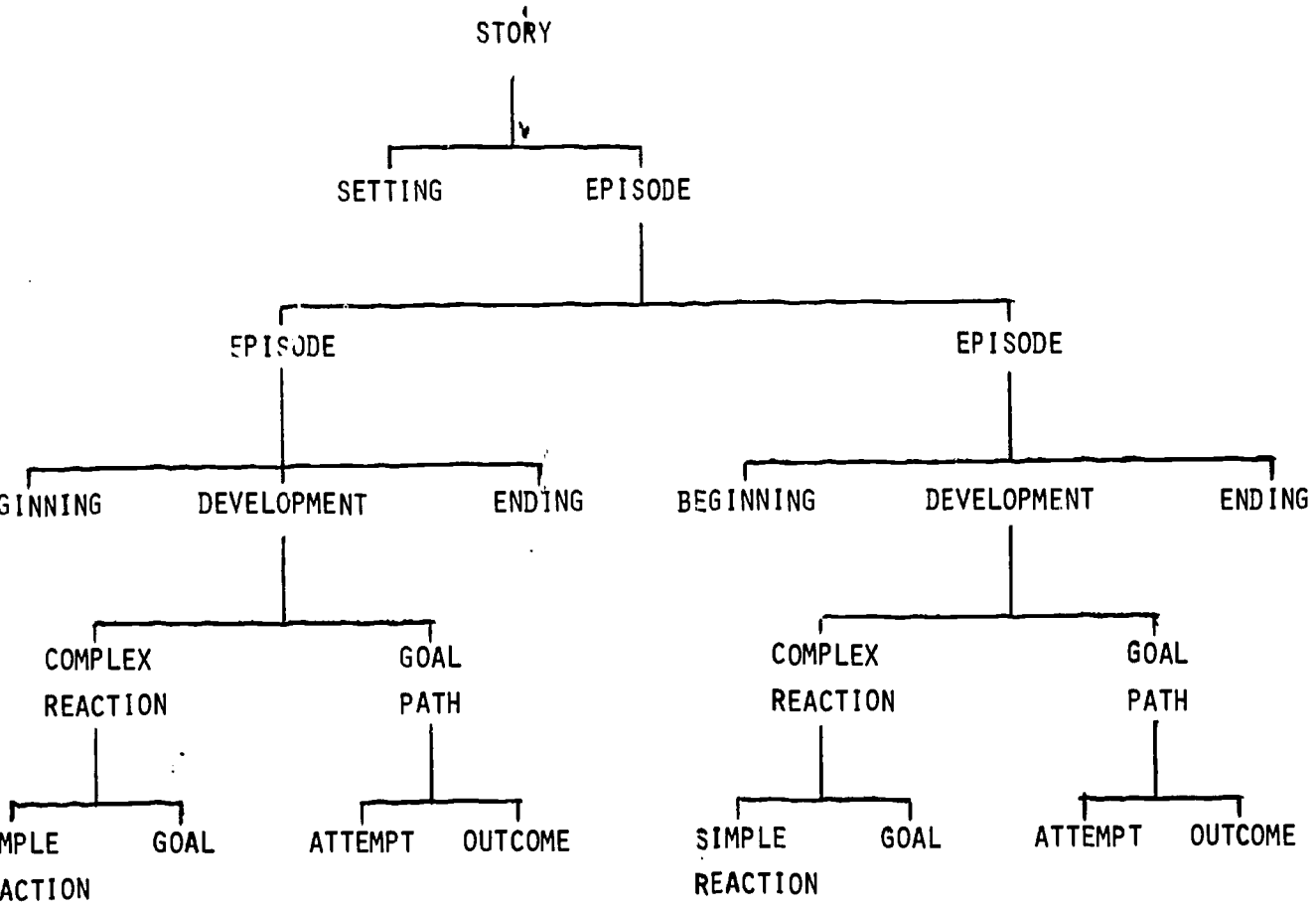
Figure Legends

Figure 1. Simplified version of the structure of a story consisting of two temporally connected episodes. The nature of the connections among the units has been omitted.

Figure 2. The structure of a hypothetical four-episode story illustrating three kinds of episode connections. Letters in circles refer to the types of connection among units; A = And, T = Then, C = Cause.

Figure 3. Patterns of recall from Liberian populations compared with American first graders, fourth graders, and college students. Taken from Mandler et. al. (1980).

Figure 4. Microanalysis of a two sentence paragraph. Adapted from Kintsch et. al. (1975).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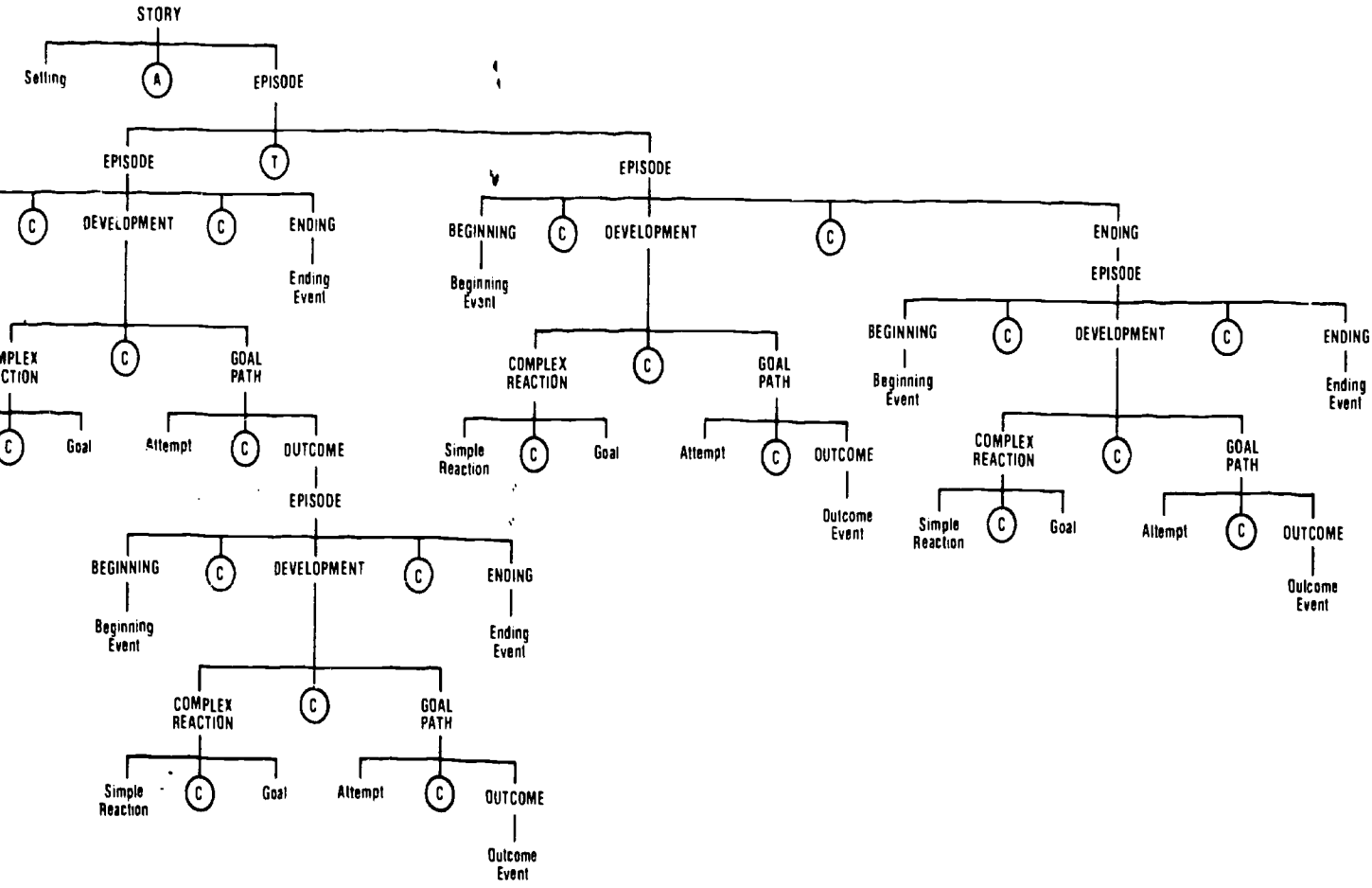
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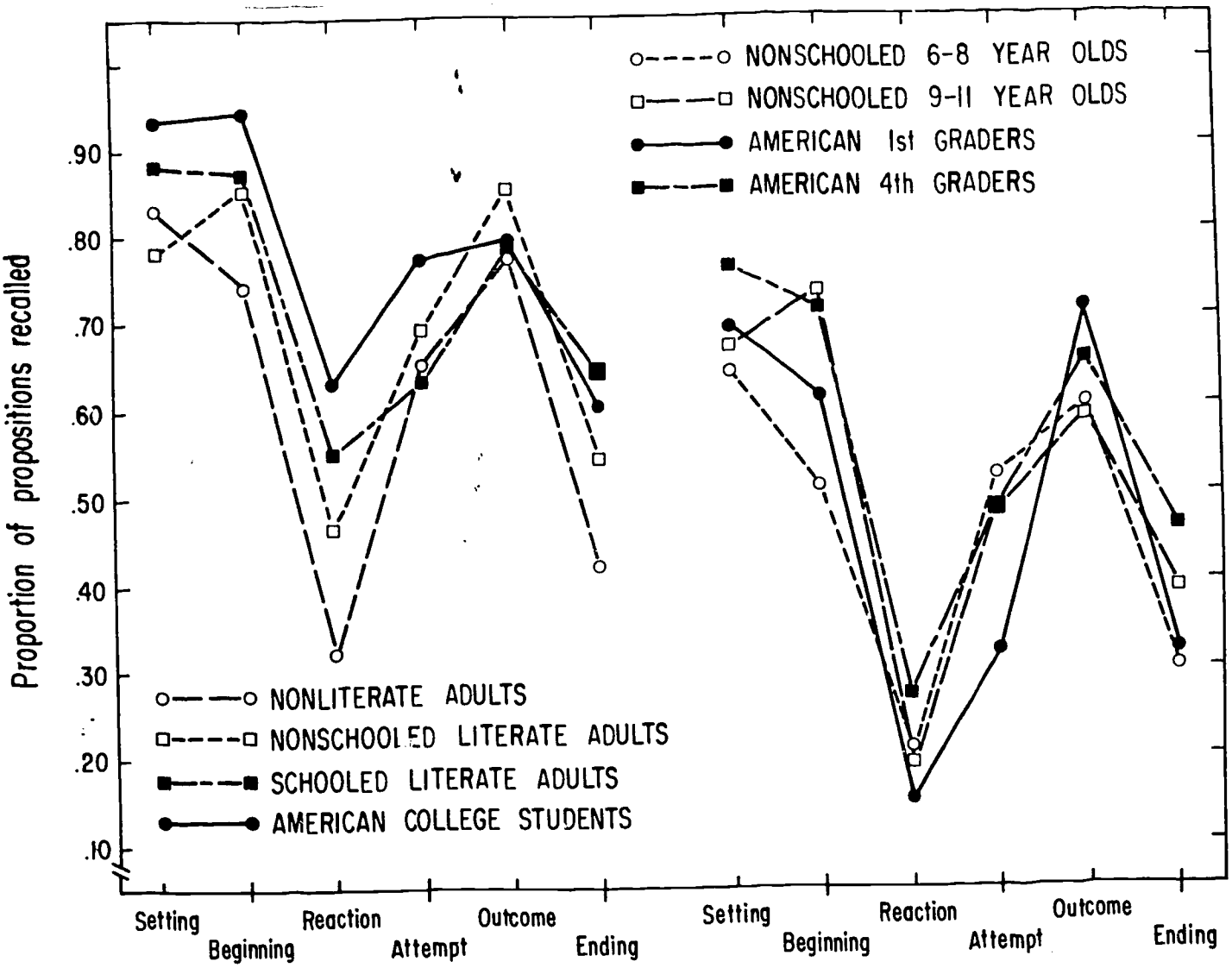
Proportion of propositions recalled
.90
.80
.70
.60
.50
.40
.30
.20
.10
NONSCHOOLED 6-8 YEAR OLDS
NONSCHOOLED 9-11 YEAR OLDS
AMERICAN 1st GRADERS
AMERICAN 4th GRADERS
NONLITERATE ADULTS
NONSCHOOLED LITERATE ADULTS
SCHOOLED LITERATE ADULTS
AMERICAN COLLEGE STUDENTS
Setting
Beginning
Reaction
Attempt
Outcome
Ending
Setting
Beginning
Reaction
Attempt
Outcome
Ending

MICROANALYSIS OF A SHORT NARRATIVE PARAGRAPH

1 (BUILD, BABYLONIAN, GARDEN)
2 (BEAUTIFUL, GARDEN)
3 (LOCATION: ON, GARDEN, HILL)
4 (PLANT, BABYLONIAN, FLOWER)
5 (LOVELY, FLOWER)
6 (CONSTRUCT, BABYLONIAN, FOUNTAIN)
7 (DESIGN, BABYLONIAN, PAVILION, 8)
8 (HAS, QUEEN, PLEASURE)

THE BABYLONIANS BUILT A BEAUTIFUL GARDEN ON A HILL. THEY PLANTED LOVELY FLOWERS, CONSTRUCTED FOUNTAINS AND DESIGNED A PAVILION FOR THE QUEEN'S PLEASURE.

ADAPTED FROM KINTSCH ET AL. (1975)